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## PTYCHODUS POLYGYRUS.

Agassiz : Poissons Fossiles III, 156 ; Dixon : Geology of Sussex, 1850, 363.  
Gibbes : Jour. Acad. Nat. Sci., 1849, 299, pl. 42, figs. 5, 6.

Dr. Gibbes, in the work above noticed, figures two teeth, from the cretaceous formation of Alabama, which he refers to *Ptychodus polygyrus*. They clearly bear a close likeness to specimens of the European species of that name.

A single specimen of a tooth, accompanying the Alabama specimens belonging to the Yale College collection, resembles the teeth of the European *Ptychodus polygyrus*. The crown is nearly square or transversely oblong, with the fore and back borders nearly straight, and the lateral borders convex. The crushing surface is moderately convex and is crossed transversely by ten coarse acute ridges, separated by similar intervals. The borders of the surface, including the posterior sinus, are occupied by comparatively fine vermicular and interrupted ridges, appearing like granulations. The coarse ridges are nearly straight, and at the end rather abruptly resolve themselves into the finer vermicular ridges of the border. From European specimens of the teeth of *P. polygyrus* and *P. latissimus*, this tooth appears especially to differ in the proportionately greater degree of fineness of the bordering vermicular ridges or granulations of the crown. Its measurements are as follows :

Width of crown 13 lines ; fore and aft 11 lines ; height  $5\frac{1}{2}$  lines ; width of fang 8 lines ; fore and aft  $6\frac{1}{2}$  lines ; thickness 3 lines.

Of other species of *Ptychodus*, Agassiz mentions teeth of *P. mammillaris*, found in the excavation of the Delaware canal, and preserved in the Museum at Paris. (Pois. Fos. III, 151.) I have seen no specimens of that species from an American locality.

## Synopsis of the Extinct BATRACHIA of North America.

BY EDWARD D. COPE, A. M.

## BATRACHIA.

The vomer is double, and usually bears teeth in this class ; the premaxillary is usually double ; Amphiuma and Spelerpes belli are exceptions. Teeth never planted in deep alveoli.

There are six orders, as follows :

## TRACHYSTOMATA.

Caudal vertebræ and frontal bones distinct.

Inferior pelvic elements not confluent.

O. o. maxillaria, prefrontalia, palatina and pterygoidea wanting ; nasalia present.

Ethmoid,\* two lateral pieces, each forming part of palate.

Mandible toothless, condyloid.

No " postorbital and supertemporal bones."

First pair ceratohyals distinct.

## PROTEIDA.

Caudal vertebræ and frontal bones distinct.

Inferior pelvic elements not confluent.

O. o. maxillaria, prefrontalia and nasalia wanting ; palatina and pterygoidea present.

Ethmoid,\* a vertical plate on each side the cerebral lobes.

Mandible toothed, teeth pleurodont.†

\* Erroneously called orbitosphenoids by me, Jour. Acad. 1866 (on Anura).

† The statement made by Dr. Gray that the teeth of Necturus are canaled, as in venomous serpents, by a channel entering at the base and issuing below the tip, appears to the writer to be of doubtful accuracy. No other opening exists in the teeth of Necturus ma-

Ceratohyals, first pair connate.  
No postorbital and supertemporal bones.

## URODELA.

Usual cranial bones present, but pterygoids reduced or wanting.  
No "postorbital or supertemporal bones."  
Caudal vertebræ and frontal bones distinct.  
Ethmoid a vertical plate on each side.  
Mandible dentigerous, teeth pleurodont.  
Inferior pelvic elements horizontal, in contact, no osseous pubis; ilium suspended to a sacral rib.  
(Mostly no quadratojugal.)

## GYMNOPHIDIA.

Usual cranial bones present and distinct, including frontals and pterygoids.  
Caudal vertebræ distinct.  
No "postorbital or supertemporal bones."\*  
Ethmoid an annulus surrounding cerebral lobes.  
Mandible dentigerous; teeth anchylosed by their bases.†  
(A quadratojugal.)

## STEGOCEPHALI.

Usual cranial elements distinct, including frontals and pterygoids, and adding "postorbitals and supertemporals."  
Caudal vertebræ?  
Ethmoid normal.  
Inferior pelvic elements distinct.  
Mandible dentigerous; teeth with anchylosed bases, or  
(A quadratojugal.)

## ANURA.

Frontal and parietal confluent, nasals wanting or rudimental; other cranial bones present.  
Postorbital, supratemporal and usually nasals wanting.  
Ethmoid an annulus (usually complete above) surrounding cerebral lobes.  
Caudal vertebræ represented by an elongate compound style.  
Inferior elements of the pelvis consolidated into a single vertical mass; ilium attached immediately to sacral vertebra.  
Quadratojugal.

## STEGOCEPHALI.

## XENORHACHIA.

The vertebral centra not ossified; ? the dentition pleurodont; teeth simple; ? no branchial hyal bones. ? Occipital condyles.

culatus than the emargination at the base of the root occupied by the growing crown of the successional tooth, as in other Batrachia. If the structure described by Dr. Gray exists, it is in a species as yet unexamined by American zoologists. Professor Winchell, of Ann Arbor, confirms my observation.

In my Synopsis of higher groups of Batrachia (Journ. Acad. Nat. Sci. 1866), I stated that *Amphiuma* possesses minute scales. Gray, in 1850 (Catalogue Brit. Mus.), makes the same statement, which Duméril (1863, Catal. Mus. Paris) contradicts. I must accord with Prof. Duméril, since a subsequent examination has convinced me that they do not exist. The specimen in which the appearance of scales was presented was mislaid at the time of writing, and I find it was due to numerous free portions of the true derm, which are continuous with the attached portions.

\* When the temporal fossa is overarched it is by expansion of the maxillary and quadratojugal. (Stannius says "squama temporalis.")

† The teeth of *Cæcilia* are compressed with a trenchant posterior edge, which is crenate, after the manner of *Megalosaurus*, *Carcharias*, etc. Thus to the numerous genera of Saurians and Selachians possessing this character, must be added a Batrachian.

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## MICROSAURIA.

Vertebral centra ossified; no branchial hyoids; teeth simple or with slightly inflected enamel, pleurodont. Occipital condyles.

## GANOCEPHALA.

Vertebral centra cartilaginous; branchial hyoids present; teeth with slightly inflected enamel, ankylosed by their bases. No ossified occipital condyles.

## LABYRINTHODONTIA vera.

Vertebral centra osseous; no branchial hyoids; teeth with much inflected enamel, ankylosed by their bases. Occipital condyles.

## XENORHACHIA.

This order I proposed for the reception of the genus *Amphibamus* Cope, in 1865. I proposed to regard, as one of its characters, the existence of opisthocœlian vertebræ. Such impressions were observed in the matrix in which the fossil was preserved, as to induce a belief in the existence of such vertebræ, and the existence of these in a well ossified condition, in the apparently nearly allied genus *Pelion* Wyman, strengthened such belief. There were actually, however, only osseous neural arches present, and I am now decidedly of the opinion that the vertebral centra were either cartilaginous or annuliform, as in *Archegosaurus*.

## AMPHIBAMUS Cope.

Proc. Acad. Nat. Sci. Phila. 1865, 134.

AMPHIBAMUS GRANDICEPS Cope, Proc. Ac. N. Sci. Phila. 1865, p. 134. Palæontology Ill. State Survey. Tab.  
Carboniferous; Lower Coal Measures, Morris Co., Illinois.

## MICROSAURIA.

This sub-order was established by Prof. Dawson, for small lizard-like vertebrates from the Coal Measures, which he thought presented points of affinity to, or should be under the Saurian reptiles, at the same time recognizing Batrachian characteristics.

After examining the evidence brought forward by Prof. Dawson, it appears to the writer that the Saurian characteristics are analogical only, and not indicative of true affinity, and that these creatures form, in fact, a series closely resembling or parallel with what was probably an immature stage of the Labyrinthodontia. They are in fact Labyrinthodonts, with simple or very slightly inflected enamel of the teeth, and with the extent of the exostosis of the cranial bones much reduced. This character has been much overrated by some authors. In the *Dendropeton obtusum* Cope the grooving and pitting exists only on the posterior parts of the cranium, and gradually disappears anteriorly. In the *Alligator mississippiensis* the same is the case.

The points in which they have been said to resemble the Lacertilia, are, 1st, the dermal scales; 2d, the parietal fontanelle; 3d, possession of ribs. All of these features belong to the Labyrinthodontia; the Xenorhachia also had scales. On the other hand, the two occipital condyles, indicating the existence of a parasphenoid bone, distinguishes it at once from all the Allantoid vertebrata, and the form of the vertebræ is very Batrachian. In the Lacertilian families of Geconidæ and Hatteriidæ only we have biconcave vertebræ, but the concavities are comparatively shallow, and the vertebræ less constricted medially than in the Microsauria. Those of the latter are much like those of Salamanders, according to Prof. Dawson's figures.

The bones figured as pelvic are unlike those of any Batrachia or Lacertilia known to the writer. But until those of the Labyrinthodontia are discovered,

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we cannot assert that they differ from the latter. The long spatuliform elements figured as pelvic are, perhaps, scapulæ, which are of not very different type in the Trachystomata, Proteida, and the Ganocephala.

The only species included in this tribe in which inflections of the enamel have been described, is the *Dendroperon acadianum*, and here it is only at the base. It is, however, not impossible that this genus should not be associated with *Hyloperon*, *Osteocephalus*, etc. The genera *Urocordylus*, *Ceratoperon*, *Leptoperon*, *Ophiderperon* and others recently described by Prof. Huxley, also belong here.

#### PELION Wyman.

In litteris. *Raniceps* Wyman, Amer. Jour. Sci. Arts, 1858, 158. Not of Cuvier (*Pediculati*).

PELION LYELLII Wyman. *Raniceps lyellii* Wyman, l. c.

This animal differs from the genus *Amphibamus* in the well-ossified vertebral axis; no remains of a tail with elevated neural spines exist in the type specimen, and no ventral scales are seen in it.

Middle Coal Measures, Jefferson Co., Eastern Ohio.

#### HYLONOMUS Dawson.

HYLONOMUS LYELLII Dawson, loc. cit. viii, 167.

The Joggins. Nova Scotia Coal Measures.

HYLONOMUS ACIDENTATUS Dawson, l. c. viii, 258.

Coal Measures; with the last.

HYLONOMUS WYMANII Dawson l. c. viii, 270.

Coal Measures, Nova Scotia; with the last.

#### PARIOSTEGUS Cope.

This genus is represented by a large part of the cranium of a Batrachian from the triassic coal measures of Chatham Co., North Carolina. If not a Batrachian, it could only belong to a ganoid fish, but though some of its characters are somewhat ichthyic, it lacks the following important elements of the ganoid structure, i. e., free post- and suborbital bones; postnasal cavities; branchiostegal, and arched branchiyl bones. On the other hand it has a large preorbital, bounding the frontal and maxillary to the nares, and the inner border of the orbit, as in *Stegocephalus* Batrachia; also a postorbital element contributing to the formation of an extended supratemporal roof.

Contrary to what has been found the case in most genera of *Stegocephali*, the maxillary appears to extend posteriorly to a free termination, as in modern Salamanders, and the supra-temporal bone presents a very prominent, obtuse, arched margin. This margin extends from the orbits on each side, and is incurved towards the posterior part of the cranium. There is therefore no quadratojugal piece.

The maxillary and mandibular pieces are slender, flat bones, as in *Menopoma*; the form of the posterior or articular portion of the latter cannot be ascertained from the specimen. The more or less exposed part of the median region of the latter exhibits a succession of shallow transverse notches, enclosing thirteen obtuse elevations. The former resemble rudimental lateral alveolæ for minute pleurodont teeth. A few other similar minute ribs, and perhaps a minute curved cone without sculpture, are the only other indications of dentition.

The bones of the upper surface of the cranium are most readily interpreted by reference to those of *Menopoma*. A pair of narrow nasals, acuminate behind, penetrate between the frontals as far posteriorly as the posterior margins of the orbits. The suture between these is very distinct, and entirely straight. The preorbitals extend to above the orbits, and there appear to cease with a transverse suture. Between these and the nasals a broad triangular element enters

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on each side, not attaining the probable position of the nostrils. Each is divided by a longitudinal groove, which is probably a suture, and which would then divide the frontals from the parietals. The frontals would then divide the parietals entirely, as they do in *Menopoma* for the anterior half of their length. This would give the frontals a narrow form, acuminate in front, and bounded behind by a regular coarse, zig-zag transverse suture. The cranium behind this point is rugose, and the surface not well preserved, and it can only be said that two irregular grooves converge to a point between the posterior extremities of the frontals, like the boundaries of the supraoccipital. The posterior boundary of the cranium with the condyles cannot be readily determined. When the postorbital roof bone is raised up, the meeting of two gular dermal bones, as I interpret them, is seen. One of these is a plate directed backwards and outwards, bearing minute radiating lines on its upper surface. It meets a similar flat plate directed forwards and outwards, with similar lines radiating to the circumference. The inner margins of these plates were not seen.

The orbits are remarkably small, and situated probably near the middle of the longitudinal measurement of the cranium. The external nares are not defined, but symmetrical depressions in the position they usually occupy in *Salamanders* are distinct.

The general form recalls *Menopoma*, particularly the necessarily small eyes. A slender curved bone with a slightly dilated and truncate extremity, lying by the cranium in connection with the mandible, is like a branchiyl of that genus. Nevertheless it cannot be positively assigned to this genus, as numerous scales of cycloid fishes are on the same block.

#### *PARIOSTEGUS MYOPS* Cope.

The surfaces of the cranial bones are little sculptured; there are small tuberculiform elevations on the parietals and more numerous ones on the preorbitals. The postorbitals show the strongest markings of elongate pits which radiate to their circumference, leaving a smooth obtuse border. The nasals present a series of small warts at a little distance on each side of their common suture, and transverse to it. The surface of the maxillary is marked with longitudinal grooves and shallow pits.

No suture separating maxillaries and premaxillaries can be traced with certainty, though the bones of the jaw are interrupted at the usual place of suture, opposite the nostril.

#### *Measurements.*

	Lin.
Length of specimen (including mandible).....	18
Width between outer convexities postorbitals.....	17
“ “ inner borders orbits.....	11
“ of same without preorbitals.....	8
“ of nasals at middle.....	2.5
“ orbit.....	1.5
Length of frontal nasal premaxillary.....	11.
“ “ supposed branchiyl.....	12.

The name is derived from the roof-like postorbitals with free lateral margin.

*Locality.*—Coal bed of the Keuper Triassic, Chatham Co., North Carolina. The species was discovered by Prof. Jos. Leidy, who handed it to me for description. It is in the Museum of the Academy of Nat. Sciences of this city.

#### *DENDRERPETON* Owen.

Journal Geol. Soc. London, 1853, p. 81.

In the form of the cranium this genus differs from *Brachydectes* and *Ophiderpeton*, much as *Menopoma* does from *Amphiuma*. Two species appear to have left their remains in the coal measures at Linton, Ohio.

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*DENDRERPETON OBTUSUM* Cope.

This species is known by a partially preserved cranium. The superior surface is exposed, the outlines of the jaws and orbits are well preserved, with the occipital condyles. The os-quadratum is directed obliquely backwards, and the angle of the mandible extends to a line a little behind that of the occipital condyles. The zygomatic arch exists in a position similar to that in which it may be seen in a few genera of Anura, as *Discoglossus* and *Pelobates*. It extends downwards and forwards from the suprasquamosal to the maxillary region, but whether it is homologically squamosal or malar, the specimen cannot show. The postorbital is present as well, and with the last, and the supratemporal forms the bony roof of the temporal fossa. A piece which may be the pre- and postfrontals combined, borders the inner superior margin of the orbit; it widens posteriorly, where it has contact with the parietal, etc., and narrows in front. Supra-occipitals form together a broad triangle on the upper plane of the cranium, of less extent than the adjoining supratemporal. The latter elements are pitted, and towards their margins radiate grooved. These sculpturings grow less on the margins of the supratemporal, and the portions of the surface of the more anterior element remaining are so slightly marked as to give the impression that the sculpturing in this species is much less than in others of the genus. A few beaded ridges are all that remain on a few of the parietals and postorbitals; the maxillaries have a slightly stronger sculpture seen in a few spots.

The general form of skull is elongate behind, and much shortened in front of the orbits. The orbits are thus altogether in front of a line equally dividing the cranium transversely, while in the *D. acadianum* Ow. they are in the middle of the skull. The outline of the muzzle in one species is thin, broad, rounded, as in the *Menopoma allegheniensis*, while in the latter it is ovate and produced.

The parietal bones extend to opposite the posterior margins of the orbits, are then gradually contracted and form an acuminate prolongation on each side the wedge-shaped frontals. The prefrontals are thickened on each side the front, behind the external nares. The sutures defining the frontals anteriorly, the nasals, and the premaxillaries behind, cannot be made out. The median longitudinal suture is a marked and zigzag one, and can be seen as far posteriorly as the anterior margin of the orbits. The external nostrils are large and opposite the inner margin of the orbit on each side. This separation of the nares is associated with a greater transverse extent of the premaxillaries than in some of the genera. These have been set with numerous teeth, judging by their small impressions; no larger ones have left traces, and no traces of any on the maxillaries. The teeth of the genera before described are all much larger relatively, indicating still further the diversity between them.

A fragment of mandible remains, but without teeth or external surface. It shows a large internal canal.

*Measurements.*

	Lines.
Total length cranium.....	25.5
Width cranium 3 lines behind orbits.....	24
“ between orbits.....	7.5
“ “ nares.....	5.
“ “ occipital condyles.....	2.2
“ of supraoccipital bones.....	6
“ of right parietal.....	6
Extent of premaxillaries.....	8.7
Length orbit.....	6

From the Coal Measures at Linton, Columbiana Co., Ohio, (West Pennsylvania Basin). Discovered by Dr. John S. Newberry.

Another cranium accompanies the collection which belongs to a species discovered in 1868.]

tinct from the last. The muzzle is not so broadly rounded, and the premaxillary teeth are relatively much larger. The sculpture is more delicate, with the ridges more acute. The orbits and nares are not defined. The maxillary is well preserved for a length of an inch; its teeth are smaller than the premaxillaries; I count four in a line; crown simple conic. External surface of maxillary not very strongly sculptured.

This species cannot be referred to its genus without further material. I therefore do not name it, hoping to avoid the unworthy practice of some, who give *prospective* names—to be applied to other peoples future discoveries, and the like.

DENDRERPETON ACADIANUM Owen, Quart. Journ. Geol. Soc., x, 1853, 81. Dawson loc. cit.

Coal Measures : Joggins of Nova Scotia.

DENDRERPETON OWENII Dawson, Canadian Naturalist and Geologist, viii, 161.

Coal Measures : as the last.

#### HYLERPETON Owen.

HYLERPETON DAWSONI Owen, Journ. Geol. Soc. Lond., 1862, 241. Dawson, Canadian Naturalist and Geologist, viii, 272.

Carboniferous Coal Measures. The Joggins, Nova Scotia.

#### BRACHYDECTES Cope.

This genus is indicated by two rami of a mandible, and a portion of a premaxillary only. These, when compared with those of *Oestocephalus* and *Dendrerpeton* from the same locality, and with others described by authors, are so much stouter, *i. e.* shorter and more elevated, that they evidently pertained to a genus not hitherto known. The genus further differs from *Oestocephalus* in having the teeth of equal size to the posterior parts of the series, that is to the base of the elevated coronoid process. The teeth are elongate cylindric cones, with their acute tips turned a little posteriorly. The fractured ones display a large pulp cavity. The three premaxillaries preserved are similar but without curvature of the tips. They do not exhibit striæ or any other sculpture. So far as the remains known go, the genus is nearer *Hylerpeton* than any other. The latter does not give any indication of the very elevated coronoid process of *Brachydictes*, though the external portion of the dental bone in that region being lost, little can be said about it. Prof. Owen's plate indicates a ramus whose depth at the last tooth enters  $8\frac{1}{2}$  times the total length. In our species this depth enters about five times. There are at least nine teeth in the Nova Scotian species; seven in the present one.

#### BRACHYDECTES NEWBERRYI Cope.

This species is represented by one nearly perfect ramus mandibuli, one dentary bone, and one premaxillary probably not complete.

The dentary bone appears to have been attached by suture to the articular and angular, as its free margin has very much the outline of that suture in *Amphiuma* and lizards. The coronoid process would also seem to be a part of the same bone as in *Amphiuma* and *Menopoma*, and not composed of a coronoid bone as in lizards. It rises immediately behind the last tooth, and displays no suture.

The lower portion of the dentary is prolonged into an acute angle. This is separated by a deep and wide concavity from the superior posterior prolongation, which is obtuse and rises at once into the coronoid process. Teeth on this dentary seven; the same number is on the preserved ramus; this number I suspect to be complete or nearly so. The teeth terminate at the obvious termination of each ramus, which is it is true slightly obscured. The teeth are the longest of the *Microsauria* in relation to the depth of the ramus, equaling the largest in *Ophiderpeton*. They are doubtless exposed, as are some of

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those of the last named genus, by the splitting away of the outer parapet of the dentary bone. As no traces of alveoli have been thus rendered visible, I suspect the dentition to have been pleurodont, as in existing Batrachia.

No external surface of the mandible remains, but there are no impressions of sculpture on the matrix. A little external face of the premaxillary displays none.

*Measurements.*

	Lines.
Preserved length of ramus (imperfect).....	11.
Depth at last tooth.....	2.
Length of exposed tooth.....	1·7
“ dentary.....	7·5
Depth at coronoid.....	3·5
“ at first tooth.....	1·3

*SAUROPLEURA* Cope.

Neural and haemal elements of the caudal vertebræ elongate, distally dilated and grooved, attached to contracted bases. Ventral aspect defended by a series of oblique dermal ribs on each side, which meet anteriorly on the median line. Limbs distinctly developed. Ribs long, well developed. Scales none.

No dermal bones have been discovered, nor are any portions of the cranium known.

This genus is allied to the *Urocordylus* of Huxley, recently discovered in the coal measures in Leinster, Ireland. It differs only in the presence of elongate lizard-like ribs (whence the name), and in the absence of “oat-shaped scales” of the upper surfaces.

It is a matter of much interest in American palæontology that this remarkable type should be found to occur in our coal measures. It was first announced by Dr. Newberry at the meeting of the American Association for the advancement of Science for 1867 (see Proceedings, p. 144), as a supposed *Urocordylus*, occurring with *Ophiderpeton*. He mentioned at the same time the discovery of the ganoid *Dinichthys* Newb.

The forms discovered by Dr. Newberry have an interesting relation to those of Ireland, such as types of the present period frequently present.

The genera may be thus parallelized; where no representation exists, we may look forward to a future discovery to supply the present want:

<i>Ceraterpeton</i> Huxl.,	represented by	
<i>Urocordylus</i> Huxl.,	“ “	<i>Sauropleuræ</i> Cope.
<i>Lepterpeton</i> Huxl.,	“ “	
<i>Dolichosoma</i> Huxl.,	“ “	<i>Molgophis</i> Cope.
<i>Ophiderpeton</i> Huxl.,	“ “	<i>Oestocephalus</i> Cope.
		<i>Brachydictes</i> Cope.
<i>Herpetocephalus</i> Huxl.,	? ?	<i>Dendrerpeton</i> Ow.

Of the American genera, *Sauropleuræ* and *Oestocephalus* exhibit the peculiar ventral dermal armature of *Urocordylus* and *Ophiderpeton*, while *Molgophis* does not possess it, nor *Dendrerpeton*, if our species truly belongs there.

The museum of Columbia College, New York, contains portions of two species of *Sauropleuræ*, but both unfortunately represented by portions only of the vertebral column. These are, though closely resembling the species described by Prof. Huxley, sufficient to demonstrate marked generic distinction. This is further established by the remains of the trunk of a third, and larger species, whose relationships can be shown to lie within this genus. This individual has been spread over a surface of the coal slate, exhibiting ventral armature, dorsal region with ribs, and anterior and posterior limbs. Of skull and caudal vertebræ nothing remains.

The dermal riblets are arranged as in *Urocordylus*, *i. e.*, in parallel lines directed obliquely forwards and continuous on the median line, forming there a  
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chevron, directed forwards. The striæ are not so closely placed as in *U. pectinatus*, but are separated by grooves wider than themselves.

The humerus, ulna, and radius are rather stout, and of a size relative to the body, as in common types of existing *Sauria*; the ulna and radius separate. There is no carpus, but five well-developed digits have phalanges in the following numbers, commencing on the inside: 3—4—5—6—5. The last phalange of the second is obscured, and it is not positive that the number is as given; it is more probable than that it should have been 3. The outer toe has been more slender than the others; the distal phalanges of all the toes are short conic, as in *Salamanders*. Thus this form differs much from *Amphibamus*, where the numbers are 3—3—4—5—4, showing a lower development of limbs.

The ribs are long and curved, as in *Reptiles*, and judging by their distances the vertebræ are short; the latter are not well defined, but there is no indication of prominent spines of any kind.

The pelvic bones and portions of those of the hind limbs are present, but so obscure and confused as not to be made out. Enough remains to show that the hind limbs are considerably larger than the anterior.

#### *SAUROPLEURA DIGITATA* Cope.

This species had a length of body about equal to that of a fully-grown *Chamaeleo vulgaris* of the largest size, or of a half-grown *Menopoma*. Thirteen ribs on one, and several on the other side, are preserved; where they terminate, probably at the pelvic region, some small or rudimental ribs project from the two or three first caudals. Three ribs and their interspaces extend over five lines. The humerus is broken, but its length can be clearly made out to be seven lines; it has no condyle, and is dilated at both extremities. The ulna and radius are distinct, truncate, hollow, and dilated at the ends. Length of ulna 5.1 lines, distal width 1.8 lines. Carpus not ossified. The fourth toe is considerably longer than the others, the fifth is next, and reaches the basal third of the antepenult phalange of the fourth; the third is very little shorter; the first is not quite so long as the first two of the third. The bones of the hind limb are not readily distinguished. They are evidently much longer and larger than the anterior; no part of a foot is preserved.

This form is probably allied to *Urocordylus*. It has relatively much stronger ribs in relation to the vertebræ than we have seen in that genus, and there is no evidence of the existence of the peculiarly formed spines of the vertebræ characterizing the latter. The limbs are relatively much stronger than in *Ophiderpeton*, and it lacks the peculiar dermal armature of that genus.

#### *SAUROPLEURA PECTINATA* Cope.

This species is represented by portions of the vertebral columns of four individuals. In two of these, vertebral centra are discoverable; in one quite definitely. They are slightly constricted medially, and without ridge or process.

The neural and haemal spines of superior and inferior lines are similar, and in the specimens undistinguishable. The dilated portions form nearly equilateral triangles, which stand on moderately short pedicels. They are weakly ridged, and each ridge is prolonged into a narrow acute tooth, beyond the margin, of which eleven may be counted on one of the best preserved. The longitudinal striæ are terminated near the pedicel by two others, which cross obliquely from each side, and, meeting, present an appearance similar to an overlapping of each margin. The edges of the spines form a continuous line.

As in the other species, there are no indications of other processes, nor of dermal scales.

The smallest of the specimens shows that in front of the region furnished with the peculiar spines described, the body is furnished with a mass of bristle- or hair-like scales. The grooved neural spines are slightly displaced anteriorly, and the bristle-like mass looks like a continuation of their striæ, and it is not easy to find any line of demarkation between them. The serrate spines are

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continued further forward on one side than the other. These linear scales were arranged as in other genera, in lines which converge forwards to the median line. They are somewhat obscured in the specimen, but it can be determined that they are continuous on the median line. Whether this is the posterior or anterior portion of the body cannot positively be determined from the specimen; it is, however, most likely the posterior, for near the posterior portion of the striate surface a weak pair of limbs is given off on each side. On the right, a moderately stout ? femur is followed by a broken tibia and fibula, and by five slender, closely appressed metatarsals. The last are about two-fifths as long as the space between them and the femur; beyond them a few slender phalanges are moderately distinctly defined. The tibia is more distinct on the left, but no tarsus or phalanges; some of the metatarsals are preserved here also. Length of limb to end of metatarsals equal to five vertebræ in juxtaposition, measured along the edges of the neural spines. The limb has been slender, especially the hand.

The above specimen enables me to assign, as the ventral armature of this species, a closely packed series of V-shaped grooves, which lie in connection with an obscure vertebral column, on the block containing one of the typical specimens of this species. They are not continuous with any of the series exhibited on other parts of the block; some of these at least are the doublings of the slender animal, and this ventral portion has been displaced. The grooves are perhaps the impressions of hæmapophysial rods, vastly more numerous, however, than the number of vertebræ; perhaps they are rather the dermal armature. Huxley figures a portion of this as on the block with *Urocordylus wandesfordii*, but does not refer it to its precise relation to the animal. A few well-developed ribs are preserved with this portion,—the only ones I can refer to this species. The vertebræ are partly enclosed in matrix, partly impressions. The neural spines, though expanded antero-posteriorly, are less elevated than in the caudal region, and have left no traces of their characteristic ribs or serration.

The number of spines in the type specimens is six in a half-inch; in the smallest, just described, ten in the same distance. The height of the spine in the former is 1.15 lines.

As the characters of this species are most determinable, I regard it as the type of the genus *Sauropleuræ*.

#### *SAUROPLEURA REMEX* Cope.

This species is larger than the *S. pectinata*, and about equal to the *Urocordylus wandesfordii* Huxl. The caudal spines differ from both in the greater attenuation of the hæmal series, and the presence of a basal lamina on the neural.

It is represented by a portion of the vertebral column three inches in length. In this space may be counted twenty-four vertebræ. Such of the latter whose outlines are visible display centra, characteristic of the genus; their terminal concavities conic, with apices meeting medially; zygapophyses present; and their length a little greater than their depth.

The characteristics of the species are the remarkable length and slenderness of the fan-shaped neural and hæmal spines, and the absence of an acute serration on their margins. In this species the spines have a laminiform expansion at the base in their planes. In the other species here described these spines are not only relatively broader and more fan-shaped, but they are acutely serrate on the margin and constricted at the base.

In *S. remex* the dilated neural spines are a little more than three times as long as they are distally wide, while the hæmal spines are a little narrower. The neural spines stand about the middle of the centrum. The basal half is furnished with an anterior ala, which leaves the anterior margin rather abruptly and extends to the next spine in advance. It returns gradually to the centrum and is separated from the articular face of the latter by a notch. A

similar ala exists on the posterior margin of the neural spine, which extends for a shorter distance above the base, and is narrower than the anterior. Each spine presents a median groove on its surface, which extends half way to the base or further; on each side of this are some three other grooves, which extend but a short distance; surface otherwise smooth. The ends of the grooves slightly notch the truncated end of the spine.

The hæmal spines are on the posterior portions of the centra, and in contact with the anterior part of the basis of those succeeding. They are without the dilatations of the neural spines, and are directed rather more obliquely backwards. They are similarly grooved, though without that so distinctly median, seen in the neural series.

Both neural and hæmal spines become larger towards the posterior part of the vertebral column. There appear to be no zygapophyses nor diapophyses, nor rudiments of ribs. The centra are rather stout, and somewhat constricted medially. There are no traces of dermal armature of any kind.

#### Measurements.

	Lines.
Length of a posterior centrum.....	1.2
Depth " " ".....	1.
Length neural spine of adjoining vertebra.....	4.4
Basal width.....	1.4
Median width.....	.9
Distal width.....	1.1
Length of a more anterior neural spine.....	4.3
Distal width " " " ".....	1.5
" anterior hæmal spine.....	4
" width " ".....	1.4

From the Coal Measures, the Western Pennsylvania and Ohio Bituminous Basin, at Linton, Columbiana Co., Ohio, near the Ohio River. Prof. J. S. Newberry.

#### ŒSTOCEPHALUS Cope.

This genus is known from a single species as yet. As before remarked, it represents in many respects the Ophiderpeton of Huxley, and has been alluded to by Dr. Newberry as the same. It, however, differs markedly in the narrow lanceolate form of the head, with probable accompanying peculiarities of detail, and in the presence of limbs, which have not been found in the Irish genus. The form of the head is somewhat nearer that of Lepterpeton Huxl., but the limbs of the American genus have as yet been seen as one pair only, and very small, while in Lepterpeton there are two pairs, which are large. The general form of the body of Œstoecephalus is more snake-like.

In more detail, we have an elongate lanceolate head with little or no sculpturing of the external surface of the bones. The angles of the mandibles are much prolonged backwards as in Archegosaurus and frogs, and the well developed ribs commence but a short distance behind the head. The vertebræ are slender, and furnished with well developed diapophyses. A pair of symmetrical bones, whose impressions are seen posterior to the occipital region, look like ceratohyals or small scapulæ, and one of them is continuous with a second piece, which occupies the place of a humerus. A third piece follows, which is probably ulna; no radius or manus is preserved. This then is a rudimental fore limb, situate very close to the head. The skin has been occupied by a great number of closely packed, curved, spine-shaped scales. They have occupied the ventral integument passing from the median line of the belly outwards and posteriorly, having acute tips which may have penetrated the skin on each side; whether such tegumentary spines protected the back cannot now be determined.

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**OESTOCEPHALUS AMPHIUMINUS** Cope.

This species is represented by the imperfect crania and anterior portions of the bodies of two individuals. They indicate an animal of the average size of the *Amphiuma* means.

The extremities of the vertebræ are deeply concave, but the centra are so long as to prevent the concavities entering more than one-fifth of the latter, each. The diapophyses are behind the middle, and are broad, curved backwards, and acuminate, as in *Amphiuma*. The centra have a prominent median line below, with a longitudinal concavity on each side. Five of them a little exceed an inch in length. Neural spines are nowhere visible. The humerus is longer than the scapula and is considerably dilated distally; the scapula slightly dilated at its superior extremity.

The dermal armature commences immediately behind the head, and forms a band of 14 lines in width; measuring across the spine-like scales, in a width of a line, four cylinders may be counted. The external portions are carried backwards, the interior nearly straight, those of the anterior more delicate than the posterior.

The head is wedge-shaped with regularly acuminate sides. The top of the cranium is somewhat broken in the specimen; the portions preserved are smooth, and the longitudinal suture is distinct for a considerable distance. The angle of the mandible is produced considerably behind the occiput and is enlarged and rounded. The end of the muzzle is broken away, and the region of the orbits so fractured as to render their precise location uncertain. The superficial layer of the cranial bones is nowhere clearly visible, so that it cannot be ascertained whether it is sculptured or not. The quadrate bone projects well posteriorly. Some fragments indicate small cylindric teeth, as in *Amphibamus*, but they are not characteristic.

*Measurements.*

	Lines.
Length cranium without muzzle.....	17.3
Width " posteriorly.....	11.5
Length scapula.....	2.1
" humerus.....	2.5
" of sixth vertebra from skull.....	3
Extent diapophyses.....	3.5
Width centrum.....	1.5

This species was discovered by Prof. Jno. S. Newberry, at Linton, Eastern Ohio, in the slate of the coal measures. Mus. Columbia College.

The characters of the genus are further shown by a part of another individual in the same coal slate matrix. The cranium and anterior portion of the vertebral column only are preserved, the latter so much injured as to render the vertebral characters very obscure. As in the other, the bristle-like scales extend along the dorsal region to near the cranium. The anterior two-fifths of the ventral side shows a large number of small oval scale-like bodies, which belonged undoubtedly to the animal and were probably dermal scales. They are, however, neither regular in form or position. Close behind the head two or three long bones of the fore limbs have been exposed. They are slender, and similar to those of the last specimen.

The cranium, though without the muzzle, shows its long wedge shape. The maxillary bone cannot be distinguished, nor can the orbits be made out; one ramus mandibuli is pretty well preserved; it shows no coronoid process. Twenty-one teeth may be counted on a portion a little more than one-third its length. The anterior eleven of these are abruptly longer and stouter than the others. They are, except a few most anterior, in pairs, *i. e.* with a slight vacancy between every two. The larger ones were broken at the bases, exhibit a moderate pulp cavity; the smaller, a large one extending to near the tip. Several, though not all of the larger teeth, display a shallow groove on the ex-

ternal face to near the tip, which is probably owing to pressure, and a partial crushing. The points of the larger teeth are rather abruptly acute, and turned abruptly backwards. A portion of their increased length ( $\cdot 25$ ) is to be attributed to the splitting off of the external dentary margin, and the exposure of the roots. No alveoli are shown, and the dentition is probably pleurodont, with ankylosis of expanded base as in true Labyrinthodonts.

#### MOLGOPHIS Cope.

This genus is established on remains represented by three specimens, which are two series of dorsal vertebræ with ribs, and a series of caudals. One of the dorsal series embraces sixteen vertebræ, the other fourteen; the caudal series, twenty-two.

From its serpentine form this genus may be compared with the *Dolichosoma* of Huxley, though a close relation does not exist between them. In the Irish genus the series of caudal vertebræ is quite short, and the ribs are short and but little curved. In *Molgophis* the tail has been like that of an elongate serpent, and the ribs are as well developed as those of many reptiles.

Though no limbs or arches can be certainly found, a rather quadrate, parallelogrammic piece, about as long as the diameter of a vertebra, may be a femur. This is, however, very doubtful.

The characters of the genus are, a long serpentine body, without dermal armature, so far as discoverable; the vertebræ large and broad, with very prominent zygapophyses and moderate neural spine, those of the caudals without narrowed bases (and grooved or serrate edges, most probably). ? Limbs and cranium unknown.

This genus differs from *Urocordylus* in its caudal vertebræ, and from *Ophiderpeton* in its dorsals; the latter, in their zygapophyses projecting laterally, resemble those of *Amphiuma*. It differs from *Sauropleuria* in the absence of ventral dermal bands and in the longer body, without indication of limbs. The size of the vertebræ would indicate a body of the size of a rattlesnake, (*C. horrida*), and therefore too large for the species named *Brachydictes newberryi*.

The ribs are long, and though the head is not bifurcate, there appear to be both tubercle and head on the dilated extremity. They show themselves, where crushed, to have had a large median vacuity.

#### MOLGOPHIS MACRURUS Cope.

The neural arches, viewed from above, have a posterior V-shaped outline, from the fact that the broad zygapophyses meet on the median line, and spread out distally over the broad anterior ones adjoining. The latter appear to be somewhat concave, and to border the former exteriorly as well as inferiorly. The base of the neural spine extends to the posterior emargination, but not quite to the anterior. The breadth of the dorsal vertebra above is equal from the emargination behind to the anterior margin of the anterior zygapophyses.

The caudal series must have been very long, as there is very little diminution in the size of the vertebræ throughout the series preserved. They present much the same form as the dorsals, but are more contracted medially, and the zygapophyses have a more transverse direction. There may indeed be a diaphysial element beneath these, but the two cannot be distinguished if so. They are connected by longitudinal impressions indicating the existence of the tendinous bands in the longitudinal muscles seen in *Amphiuma*, or the osseous spicules in the same situation in birds. The neural spines, indicated by their narrow bases, occupied the lengths of the neural arch, and remind one of *Amphiuma*.

The ribs are long for a Batrachian, but shorter than in a reptile. They are well curved, chiefly near the proximal extremity. The longest I can find, measured by a chord, equals two vertebræ and two-fifths. Three vertebræ

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measured along the median line above equal eleven lines; one of these is 3.6 lines in width above; width of a (?) posterior caudal 3 l.

This animal has been, like *Amphiuma*, a snake-like Batrachian, but probably of even more elongate form. How near its affinities to this genus may be, cannot be ascertained, owing to want of important parts of the skeleton, but it differs in the important feature of the large, well developed ribs.

### LABYRINTHODONTIA.

#### DICTYOCEPHALUS Leidy.

*DICTYOCEPHALUS ELEGANS* Leidy, Proc. Acad. Nat. Sci., 1856, 256. Emmons Geology North Amer., p. 59. Tab. 31.

Triassic Coal Measures, Chatham Co., N.-Carolina.

#### CENTEMODON Lea.

*CENTEMODON SULCATUS* Lea, Proc. Acad. Nat. Sci., Phila., 1856, 78.

Triassic Shales near Phoenixville, Chester Co., Penn.

#### BAPHETES Owen.

*BAPHETES PLANICEPS* Owen, Quart. Journ. Geol. Soc. Lond. x, 1853, (xi, notes).

Carboniferous Coal Measures of the Joggins, Nova Scotia.

#### EUPELOR Cope.

Gen. nov. *Char.* Teeth subcylindric, with large pulp cavity at the basis only; external surface without grooves; dentine divided by numerous flat vertical laminae of a dense substance, probably enamel, which radiate from very near the pulp cavity to the external enamel layer.

The species on which this genus depends was originally described by the writer as a *Mastodonsaurus*. The latter genus, however, exhibits external grooves where the inflections of enamel enter and separate the dentine. These inflections, as is well known from the figures and descriptions of Professor Owen, are more or less convoluted, some of them very highly so. The laminae of the teeth of the *Eupelor* cannot be looked upon as inflections of enamel, but rather as branches. They are exceedingly thin, and our sections do not demonstrate them to be double. If they are double they are very much more attenuated than the external enamel stratum. They may be distinguished in a section of the wall of the pulp cavity at the base of the root as well as elsewhere.

*EUPELOR DURUS* Cope, *Mastodonsaurus durus* Cope. Proceed. Acad. Nat. Sci., Phila., 1866, 249.

From the Triassic Red Sand Stone near Phoenixville, Chester Co., Penn.

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### On *AGAPHELUS*, a genus of toothless Cetacea.

BY EDW. D. COPE.

During the autumn of 1866 a whale was cast ashore on the Long Beach, Ocean Co., N. J., opposite Westecunk, on the other side of Little Egg Harbor, near the residence of Wm. A. Crane. A recent visit to the spot furnished me with the means of determining the species to which this monster of the deep belonged, although not with the completeness desirable, as the tide had a short time previously taken off the most bulky part of the carcass. Thus the cranium, cervical and dorsal vertebrae, with the first ribs, the most important portions for its identification, were lost. There were preserved, however, the mandibular arch, ear-bone, one scapula and both fins, numerous ribs, many 1868.]